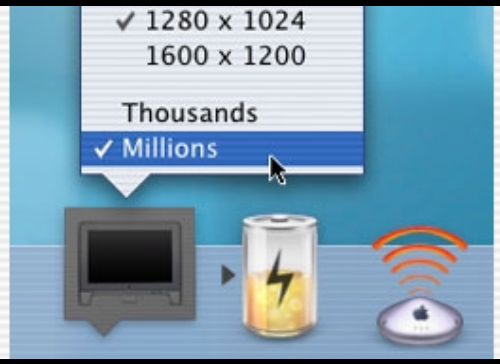
Session 203

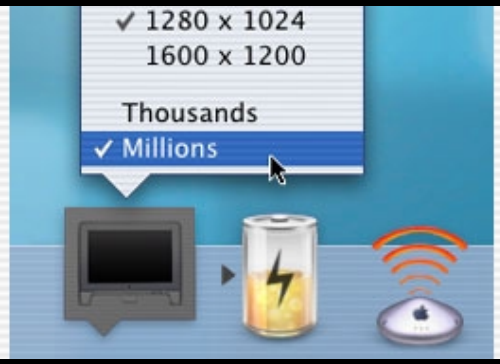
USB Overview



Craig Keithley
USB & FireWire Technology Manager
Worldwide Developer Relations

Session 203

USB Overview



David Ferguson
Rhoads Hollowell
USB Software Team

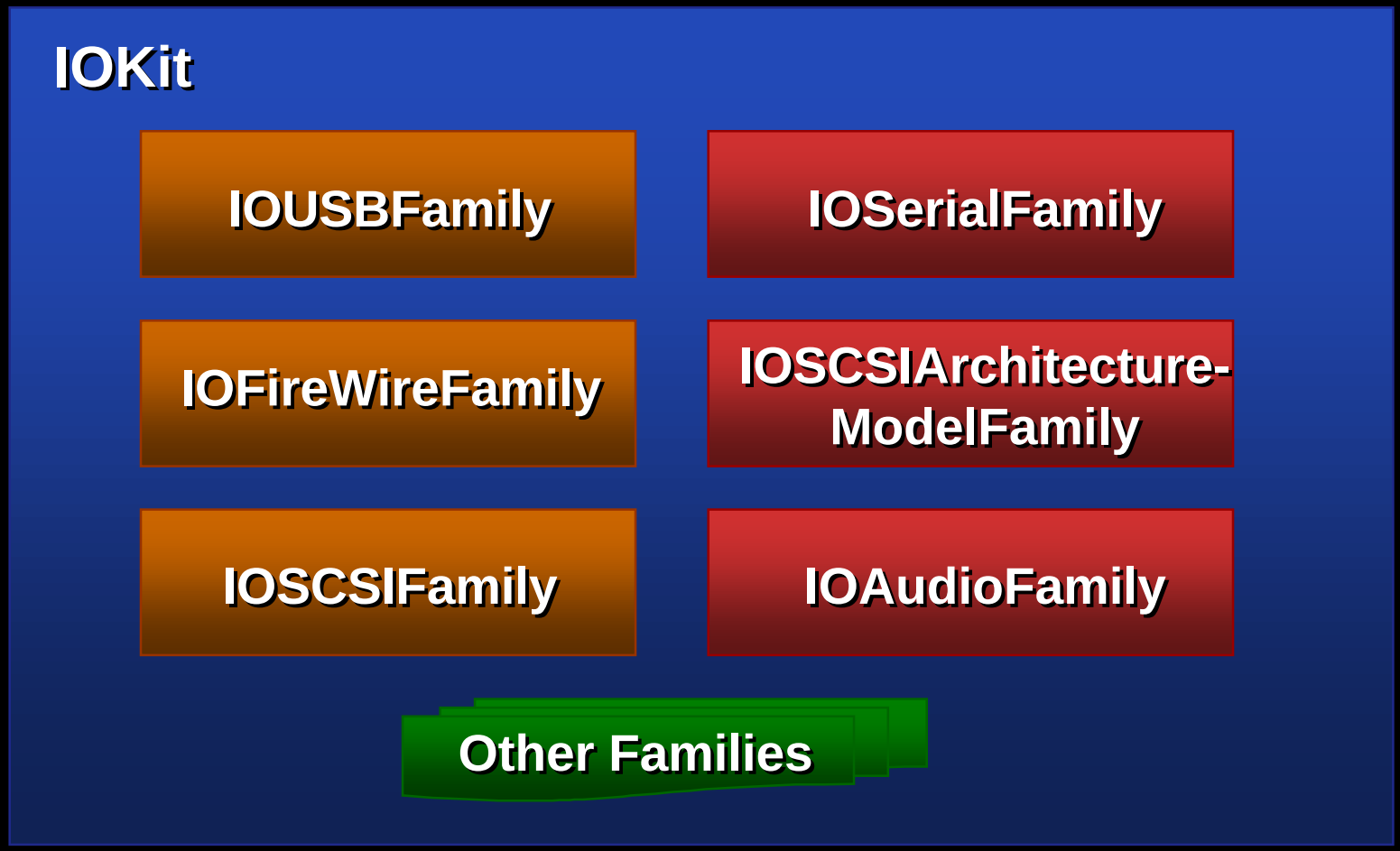
What You'll Learn

- USB hardware architecture
- USB driver architecture on Mac OS X
- Converting from Mac OS 9.x
- Kernel and user-mode drivers
- Classic support for USB drivers
- Apple's USB class drivers

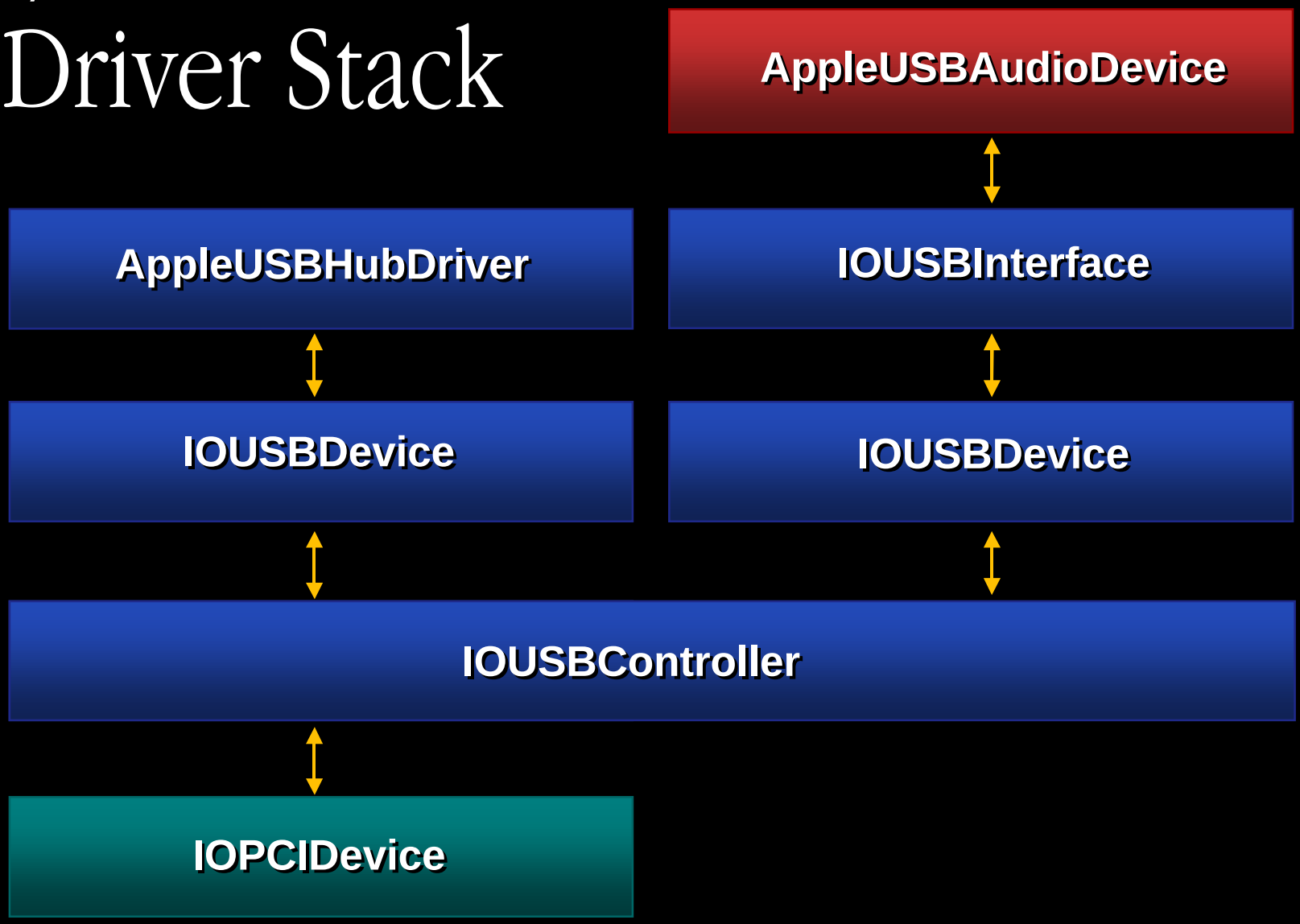
Universal Serial Bus Hardware

- Included with every Macintosh
- Compliant with USB 1.1 spec
- Two busses for increased bandwidth
- Hubs included in keyboards and monitors

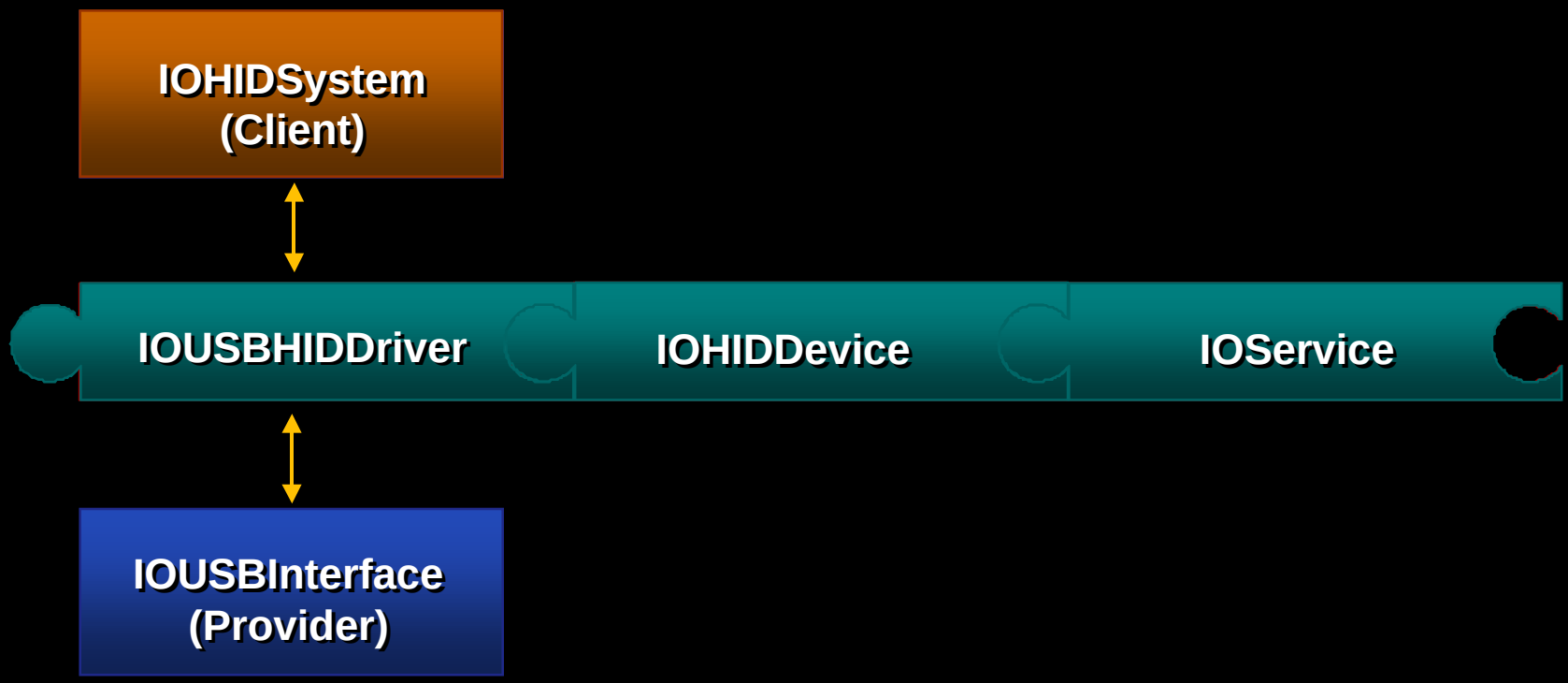
I/O Kit Family Architecture



I/O Kit Kernel Driver Stack



I/O Kit Driver Inheritance



USB API Model Comparison (Mac OS X vs. Mac OS 9)

- Similar function names/methods
- No parameter block
- Memory buffers
- Async vs. blocking

Kernel Mode Access

- IOUSBDevice
- IOUSBInterface
- IOUSBPipe

User Mode Access

- IOCFPlugins
  - IOUSBDeviceInterface
  - IOUSBInterfaceInterface

Memory Buffer Comparisons

- Mac OS 9, used held memory, passed as a pointer
- Kernel drivers use IOMemoryDescriptors
  - Not required to be virtually contiguous
  - Not necessarily mapped into kernel address space
- User-mode drivers use virtual address buffers similar to Mac OS 9 USB APIs

Async vs. Blocking APIs

- Synchronous calls (will block)
- Asynchronous calls
  - Callback in kernel
  - CFRunLoop in user mode

Matching and Loading Drivers

- Enumeration
- I/O Kit passive matching
- IOUSBFamily active matching
- “probe” method

What Happens When a USB Device Is Removed?

- Family “terminates”
- Drivers gets notification (no more I/O)
- Driver gets terminated

User Space Communication

- Uses the I/O Kit notification mechanisms to find out about device creation and destruction
- User space drivers do not compete at the same time as Kernel space drivers
- In some cases a “dummy” kernel driver may have to be used to claim the device

Discovering Devices

- Use I/O Kit Service Matching to find USB devices:

```
IOServiceMatching(kIOUSBDeviceClassName)

IOServiceGetMatchingServices(
        masterPort, matchingDictionary, &iterator);

while(usbDeviceRef = IOIteratorNext(iterator))

IOObjectRelease(iterator);
```

Sharing Device

- Exclusive access model
- Support: message method
  - kIOMessageServiceIsRequestingClose
  - kIOMessageServiceIsAttemptingOpen
- Can also register for notification
  - kIOMessageServiceWasClosed

USB in Classic

- Uses Mac OS 9 driver model
- Drivers see no difference
- Supports
  - Printing and vendor specific class
  - Other devices are expected to have Mac OS X native support
- Device sharing model

Apple Class Drivers Provided in Mac OS X

- Hub
- HID class
- Audio class
- Mass storage
- Communication devices
- Printing class

For More Information

- USB Implementers Forum
  http://www.usb.org
- Mac OS X Developer Information
  http://developer.apple.com/macosx/
- Macintosh USB Development Information
  http://developer.apple.com/hardware/usb/

Roadmap

104 I/O Kit Update: Overview of I/O Kit in Mac OS X	Room A1 **Mon., 3:30pm**
204 I/O Kit: Storage Drivers: Stay seated for our next show…	Room A2 **Tues., 5:00pm**
117 Image Capture Framework	Room C **Wed., 10:30am**
207 USB In-Depth: Details on developing drivers	Civic **Wed., 3:30pm**

Roadmap (Cont.)

FF108 Feedback Forum:
FireWire & USB:
Tell us what you think

Room J1
Thurs., 2:00pm

Who to Contact

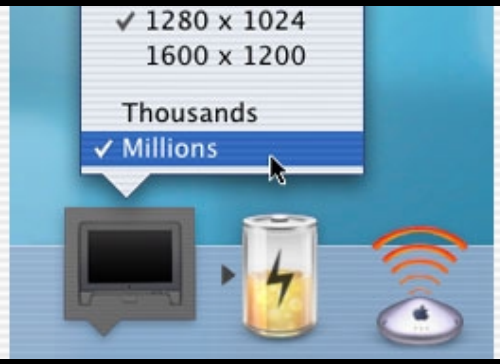
Worldwide Developer Relations

Craig Keithley
USB & FireWire Technology Manager
keithley@apple.com

USB Developer Mailing list

usb@isg.apple.com

Q&A



USB Software Team

http://developer.apple.com/events/urls.html

WWDC

Worldwide Developers Conference 2001